Badger Meter Europa GmbH

ModMAG M2000

INSTALLATION AND OPERATION MANUAL

April 2010

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1. Basic safety precautions

The electromagnetic flow meter is only suitable for the measurement of conductive fluids. The manufacturer is not liable for damages that result from inproper use or from use that is not in accordance with the requirements.

The meters are constructed according to state-of-the-art technology and tested operationally reliable. They have left the factory in a faultless condition concerning safety regulations.

The mounting, electric installation, putting into operation and maintenance of the meter is to be carried out by suitable technicians. Furthermore the operating personnel has to be trained by the operating authority and the instructions of this manual have to be followed.

Basically you have to respect the regulations for the opening and repairing of electrical equipment applicable in your country.

Repairs

Should you send back a flow meter, please take notice of the following points:

- Please enclose a description of the error as well as a precise statement of the measured medium (if necessary a safety specification sheet).
- The meter has to be in a cleaned condition (outside and inside). Especially with harmful measuring mediums you have to pay attention that there are no impurities in the pipe or at the connections.
- If it is not possible to clean the meter completely, particularly with harmful materials, do not send back the meter.

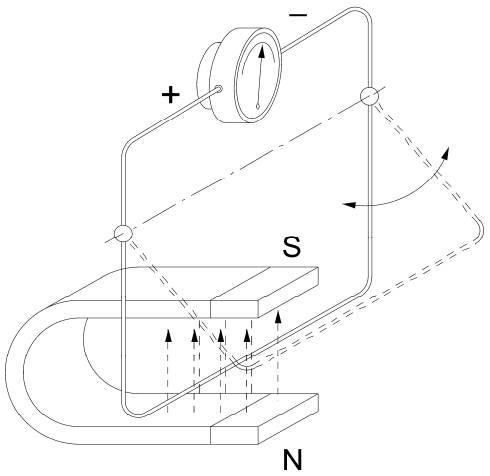
We reserve the right to repair only cleaned meters. Costs, which result from insufficient cleaning, will be charged to you.

RoHs

Our products are RoHs compliant.

2. System description

The electromagnetic flow meters are intended for the metering of all fluids with electric conductivity of at least 5 μS/cm (20 μS/cm for demineralized water). These series of meters is characterized by a high degree of accuracy. Measuring results depend on density, temperature and pressure.



Measuring principle

In accordance with Faraday's induction principle, electric voltage is induced in a conductor moving through a magnetic field. In case of the electromagnetic flow measurement, the moving conductor is replaced by the flowing fluid. Two opposite measuring electrodes conduct the induced voltage which is proportional to flow velocity to the amplifier. Flow volume is calculated based on pipe diameter.

3. Installation

Warning:
- *Installation instructions given in the following are to be observed in order to guarantee a perfect functioning and a safe operation of the meter.*

3.1 General information

3.1.1 Temperature ranges

Caution:
- *In order to prevent a damaging of the meter, you are requested to strictly observe amplifier's and detector's maximum temperature ranges.*
- *In regions with extremely high ambient temperatures, foresee a protection from direct sun radiation.*
- *In cases where fluid temperature exceeds 100°C, foresee separate amplifier and detector (separate version).*

Amplifier	Ambient temp.		-20 to + 60 °C
Detector	Fluid temp.	PTFE / PFA	-40 to +150 °C
		Hard rubber	0 to +80 °C
		Soft rubber	0 to +80 °C

3.1.2 Protection class

In order to fulfill requirements in respect of the protection class, please follow the following guidelines:

Caution:
- *Body seals need to be undamaged and in proper condition.*
- *All of the body screws need to be firmly screwed.*
- *Outer diameters of the used wiring cables must correspond to cable inlets (for M20 Ø 5....10 mm). In cases where cable inlet is not used, put on a dummy plug.*
- *Tighten cable inlets.*
- *If possible, lead cable away downwards. Thus humidity cannot get into cable inlet.*

We normally deliver the meter in accordance with protection class IP 67. If you however require a higher protection class, the amplifier is to be installed separately from the detector. If requested, we can also deliver the detector in IP 68.

3.1.3 Transport

Caution:
- *Use lifting lugs when lifting meter flow tubes that are 150 in diameter or larger.*
- *Do not lift meter on measuring amplifier or on detector's neck.*
- *Do not lift meter with a fork lift on the jacket sheet. This could damage the body.*
- *Never place rigging chains, forklift forks, etc inside or through the meter's flow pipe for hoisting the meter. This could damage the isolating liner.*

3.2 Installation

In order to provide a perfect functioning and to prevent the meter from eventual damages, please follow the following installation instructions.

Caution:
- *Carefully observe the forward flow label on the meter body and install the meter accordingly.*
- *As for detectors with PTFE liner, remove protective cap on the flange or on the threaded pipes of milk pipe screws as per DIN 11851 not until shortly before installation.*

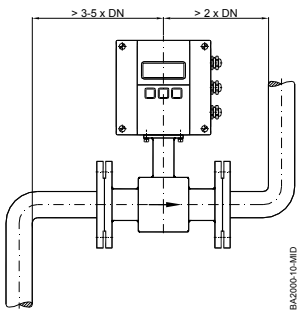
3.2.1 Meter orientation

Meters can operate accurately in any pipeline orientation. Meters can be installed in horizontal as well as in vertical pipelines.
Meters perform best when placed vertically with liquid flowing upward as it prevents solids build-up.
When installing the meter on a horizontal pipe, mount the meter to the pipe with the flow-measuring electrode axis in a horizontal plane as it prevents that gas bubbles result in a temporary isolation of the flow-measuring electrodes.

Carefully observe the forward flow label on the meter body and install the meter accordingly.

3.2.2 Inlet and outlet pipe

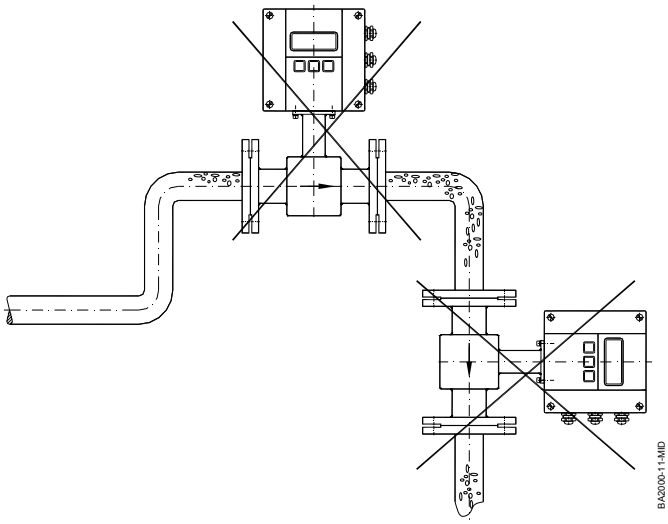
Always install the detectors in front of fittings producing turbulences. If this is simply not possible, foresee distances of > 3 x DN. Distance ought to be > 2 x DN.

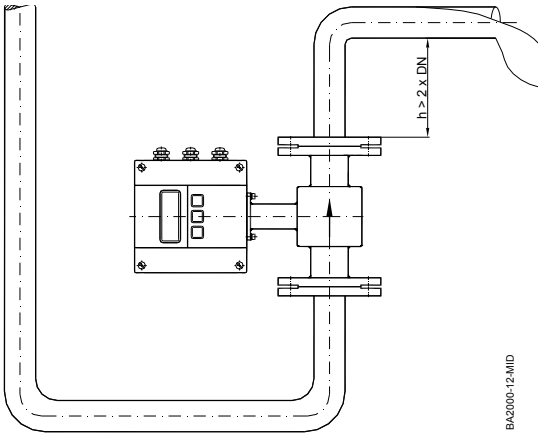


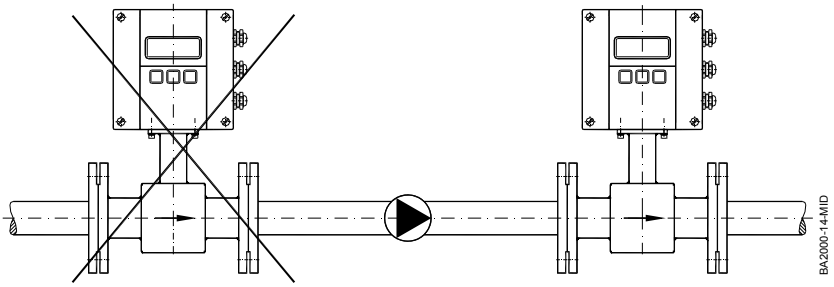
3.2.3 Meter location

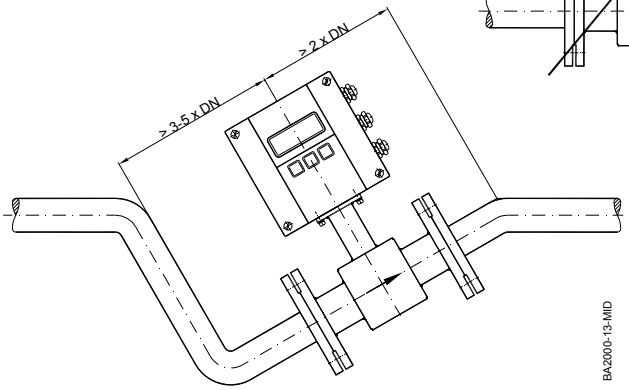
Caution:

- *Do not install the detector on the suction sides of pumps. This could damage the liner (in particular PTFE liners).*
- *Verify that the pipeline is always filled on the measuring point, if not - a correct or accurate measurement is not possible.*
- *Do not install the detector on the highest point of a pipeline system. Gas accumulation may follow.*
- *Do not install the detector in downcomer pipes with free outlet.*
- *Do not install the detector on pipes with vibrations. If pipes are strongly vibrating, make sure that detector and amplifier are separated (separate version).*









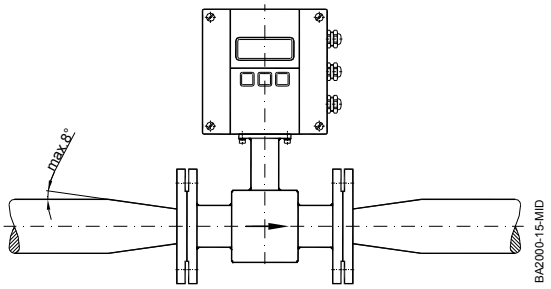
3.2.4 Pipe reducer requirements

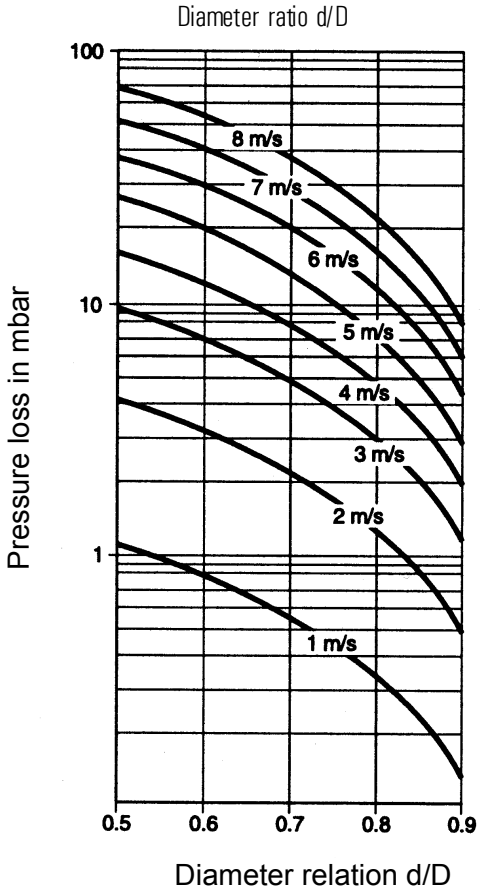
With pipe reducers as per DIN 28545 detectors can be mounted in larger pipelines.

You can determine the occurring pressure drop by using the shown nomogram (only applicable to liquids with similar viscosity like water).

Note:
- *In cases where flow velocities are very low, you can increment them by reducing the size on the measuring point and hence obtain a better measuring accuracy.*

D = pipeline
d = detector





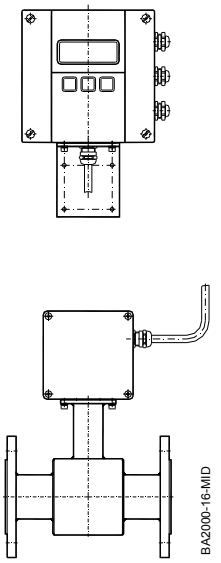
Define pressure loss:
1. Calculate diameter ratio d/D.
2. Read pressure loss depending on d/D ratio and flow velocity.

3.2.5 Separate version

Provide a separate version in the following cases:

Note:
- *Detector protection class IP 68*
- *Fluid temperature > 100 °C*
- *Strong vibrations*

Caution:
- *Do not install the signal cable close to power cables, electric machines, etc.*
- *Fix signal cables. Due to capacity changes, cable movements may result in incorrect measurements.*

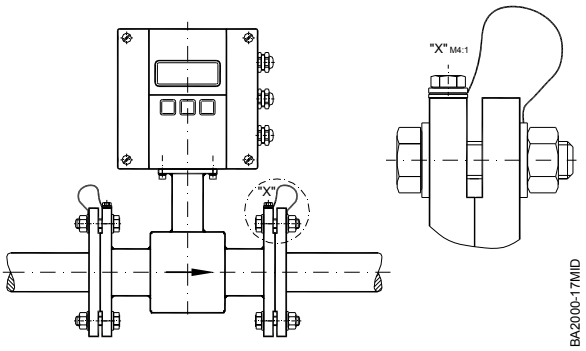


3.2.6 Grounding and potential equalization

In order to obtain an accurate measurement, detector and fluid need to be on the same electric potential.

If flange or intermediate flange versions with additional grounding electrode are used, grounding is provided by the connected pipeline.

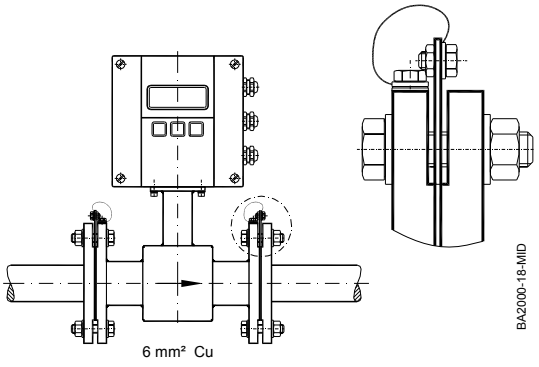
Caution:
- *In case of a type with flange a connection cable (min. 4 mm²) between grounding screw on the meter's flange to the counterflange is to be used in addition to the fixing screws. Verify that a perfect electric connection is provided.*
- *Color or corrosion on the counterflange may have a negative effect on the electric connection.*
- *In case of types with intermediate flanges, the electric connection to the detector is done via two ¼ AMP plugs installed on detector's neck.*



3.2.7 Plastic or lined pipelines

If non-conductive pipelines or pipelines lined with non-conductive material are used, install an additional grounding electrode or grounding rings between the flanges. Grounding rings are installed like gaskets between the flanges and are connected with a grounding cable to the meter.

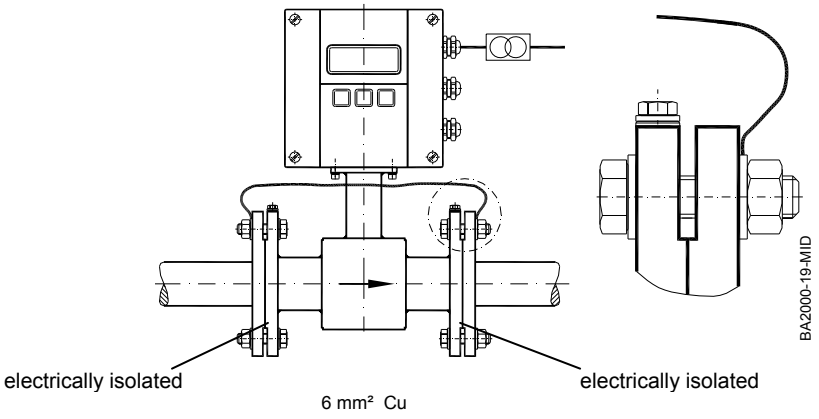
Caution:
- *When grounding rings are used, please make sure that the material is resistant to corrosion. If aggressive fluids are measured, use grounding electrodes.*



3.2.8 Pipelines with cathodic protection

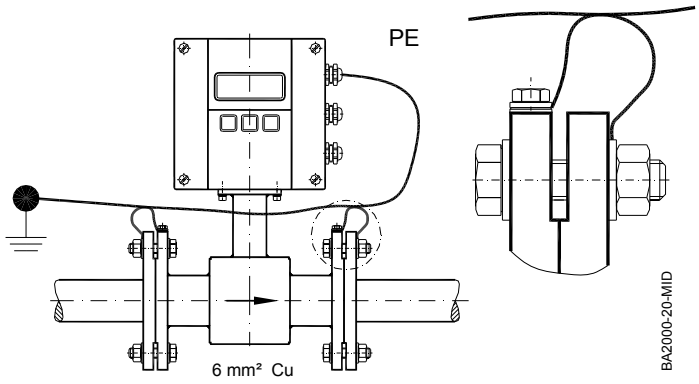
As for pipelines with cathodic protection, install meter potential-free. No electric connection from the meter to the pipeline system may exist and power supply is to be provided via isolating transformer.

Caution:
- *Use grounding electrodes (grounding rings also need to be installed isolated from the pipeline system).*
- *Observe national rules in respect of a potential-free installation*



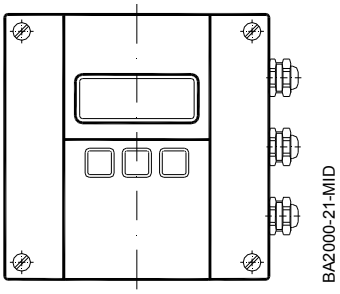
3.2.9 Electrically disturbed environment

If the pipe material is in an electrically disturbed environment or if metallic pipelines that are not grounded are used, we recommend a grounding as shown in the following picture in order to assure that measurement is not influenced.



4. Power connections

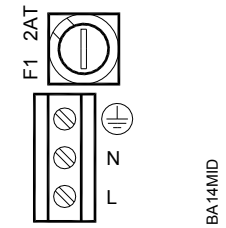
Caution:
- *For the 3 x M20 cable inlets only use flexible electric cables.*
- *Use separate cable inlets for auxiliary power, signal and input/output cables.*



4.1 Auxiliary power

Warning:
- *Do not connect meter under impressed mains voltage.*
- *Take national applicable rules into account.*
- *Observe type plate (mains voltage and frequency).*

1. Slightly loosen both of the left cover screws and loosen the two right cover screws completely. Open cover to the left side.
2. Push auxiliary power cable through the upper cable inlet.
3. Connection as shown in the picture.
4. In the following close connection cover again firmly.



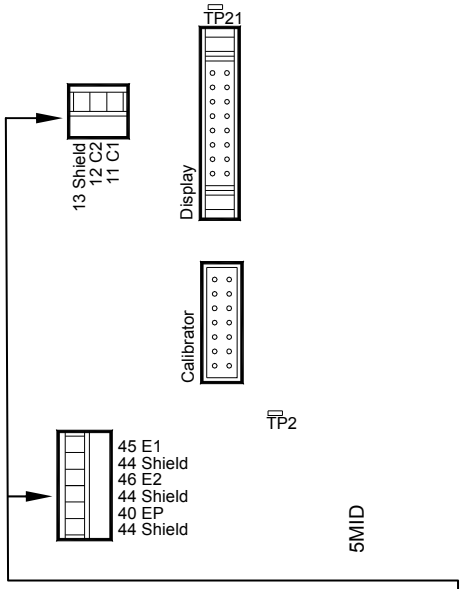
85 – 265 VAC

4.2 Separate version

Caution: • *Connect or separate signal connection cable only when the unit has been switched off.*

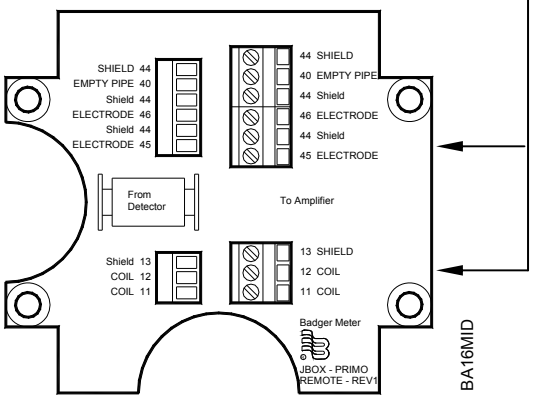
Connection in the measuring amplifier

1. Loosen both fixing screws of the connection cover and remove cover.
2. Loosen upper and lower cover screw and open cover to the left side.
3. Push signal cable on the upper side of the device through cable inlet.
4. Connection as shown in the picture.
5. Close device and connection cover again firmly.



Connection on the detector

1. Loosen fixing screws of the connection cover and remove cover.
2. Push signal cable through cable inlet.
3. Connection as shown in the picture.
4. Close device and connection cover again firmly.



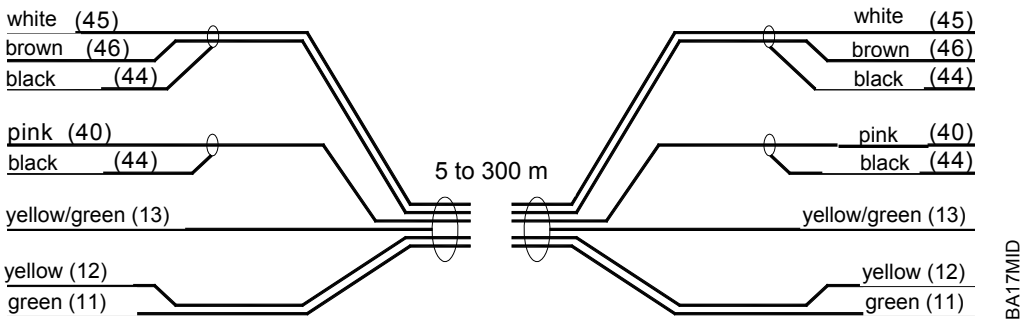
Terminal box – Terminal		M2000	Description	Wire color
Standard	Stainless steel			
11	5	C1	Coil 1	Green
12	4	C2	Coil 2	Yellow
13	PE	CS	Main shield	Yellow/Green
45	1	E1	Electrode 1	White
44*	PE	ES	Electrode shield	Black
46	2	E2	Electrode 2	Brown
40	3	EP	Empty pipe	Pink
44*	PE	ES	Empty pipe shield	Black

*) Anschlüsse mit der Nr. 44 liegen auf gleichem Potential

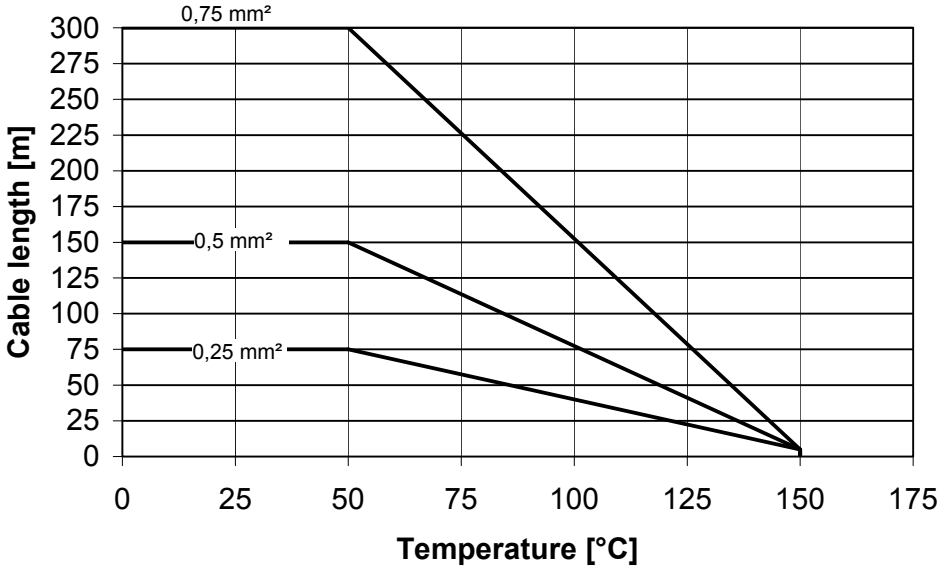
4.2.1 Signal cable specification

Note:
- *Only use signal cables delivered by Badger Meter or corresponding cable in accordance with the following specification.*
- *Take max. signal cable length between detector and amplifier into account (keep distance as low as possible).*

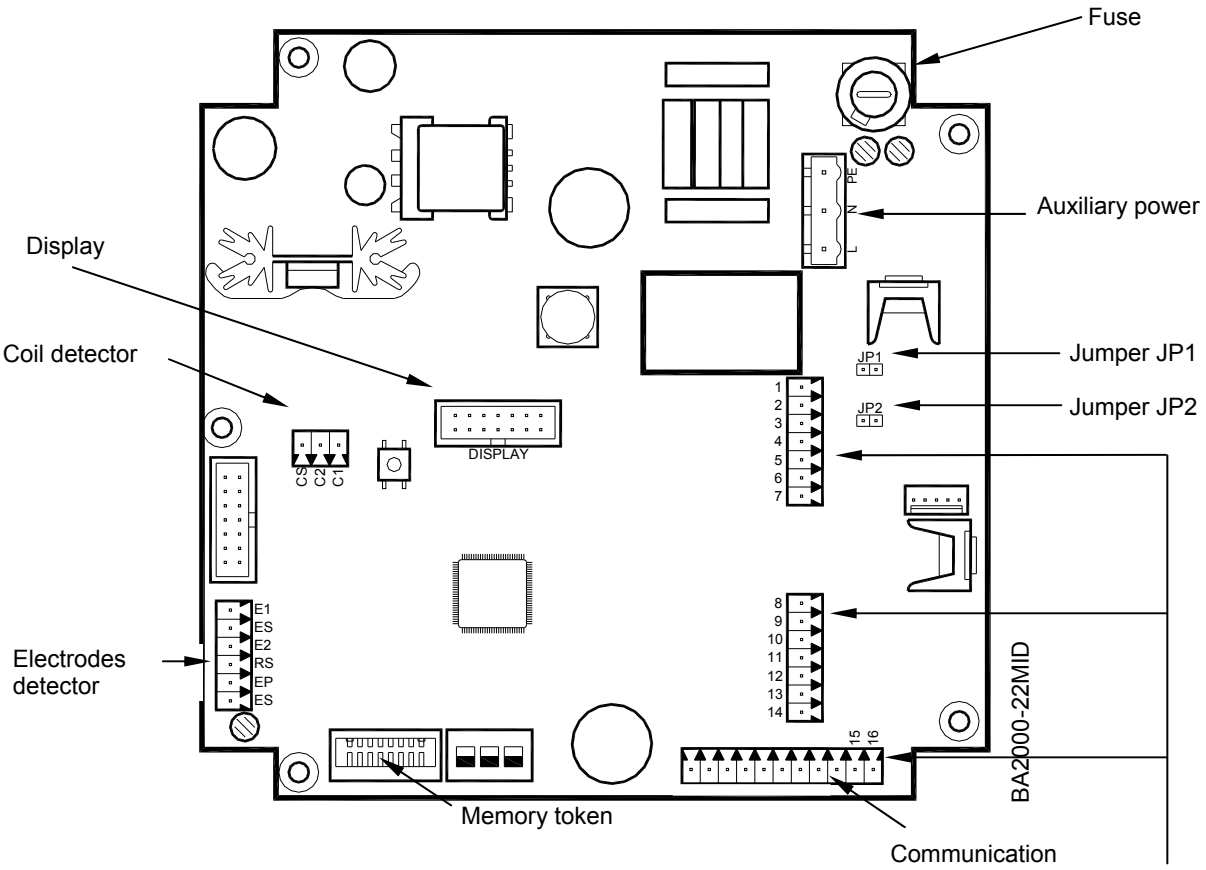
Distance	With electrode idle	Loop resistance
0 – 75 m	3 x (2 x 0,25 mm²)	=< 160 Ω/km
> 75 – 150 m	3 x (2 x 0,50 mm²)	=< 80 Ω/km
> 150 – 300 m	3 x (2 x 0,75 mm²)	=< 40 Ω/km
PVC cable with pair and total shield Capacity: wire/wire < 120 nF/km, wire/shield < 160 nF/km Temperature range –30 to +70 °C		



Maximum cable length at different fluid temperatures



4.3 Configuring input/output (I/O)



Input/Output	Description	Terminal
Analog output	0 - 20 mA 4 - 20 mA RL < 800 Ohm 0 - 10 mA	16 (+) 15 (-)
Digital output		
1	Open collector max. 10 kHz * Passive max. 30 VDC, 100 mA * Active 24 VDC, 50 mA (Jumper JP1 placed)	1 (+) and 2 (-)
2	Open collector max. 10 kHz * Passive max. 30 VDC, 100 mA * Active 24 VDC, 50 mA (Jumper JP2 placed)	3 (+) and 4 (-)
3	Open collector passive max. 30 VDC, 100 mA, max. 10 kHz or Solid State Relais max. 48 VAC, 500 mA, max 1 kHz	10 (+) and 11 (-)
4	Open collector passive max. 30 VDC, 100 mA, max. 10 kHz or Solid State Relais max. 48 VAC, 500 mA, max 1 kHz	13 (+) and 14 (-)
Digital input	5 - 30 VDC	8 (+) and 9 (-)
RS 232	Remote display information or Modbus RTU	7 GND 6 RxD 5 TxD
Communication	Optional communication ports like HART, Profibus DP, Modbus	Communication

5. Programming

Programming is accomplished by using the three functional buttons ▲,► and **E**.
You can move from the measuring mode to the programming mode by pressing twice the button **E**. While first pressing this button, you activate the backlight and while pressing it for a second time, you get into the programming menu.
The cursor → on the left side of the display is moved upward and downward with the buttons ▲/ ►. The menu manager or selection from a list is marked with the cursor and acknowledged by pressing the button **E**.
To enter a parameter, the first number is marked with an underline **0.** By pressing the buttons **+** / **-,** you can increment or decrement them. As soon as the requested number has been selected, you can acknowledge it by pressing the button **E**. After having entered the last number, the value is stored by pressing the button **E** or press the button **+** in order to edit the value again.

You get access to the individual menus through three programmable access levels: Administrator, service and user level.
Access rights of the individual menu items is shown in the following with three symbols:

Administrator

Service

User

For programming the access levels, see the chapter “passwords”.
No passwords were set at the factory.

5.1 Quick setup

The M2000 amplifier provides you with a quick setup utility that allows you to quickly set most of the important parameters like flow units, totalizer units, full scale flow and low flow cutoff settings.

Quick Setup

Flow Units

Flow units let you select among the flow units mentioned below. Flow units are automatically converted into the selected unit.

	Unit		Unit
LPS	Liter/Second	GPM	Gallons/Min.
LPM	Liter/Minute	GPH	Gallons/Hour
LPH	Liter/Hour	MGD	MegaGallon/Da
M3S	Cubic meters/Sec.	IGS	UKG/Sec.
M3M	Cubic meters/Min.	IGM	UKG/Min.
M3H	Cubic	IGH	UKG/Hour
F3S	Cubic Feet/Sec.	LbM	Pound/Min.
F3M	Cubic Feet/Min.	OPM	Ounce/Min.
F3H	Cubic Feet/Hour.	BPM	Barrel/Min.
GPS	Gallons/Sec.	--	--

<table>
<tr><th colspan="2">Quick Setup</th></tr>
<tr><td>Totalizer Unit
 </td><td>This parameter establishes the units of measure for the totalizers:
<table><tr><th></th><th>Unit</th><th></th><th>Unit</th></tr><tr><td>L</td><td>Liters</td><td>UKG</td><td>Imperial Gallons</td></tr><tr><td>HL</td><td>HectoLiters</td><td>Lb</td><td>Pounds</td></tr><tr><td>M³</td><td>Cubic Meters</td><td>Oz</td><td>Fluid Ounces</td></tr><tr><td>CFt</td><td>Cubic Feet</td><td>Aft</td><td>Acre Feet</td></tr><tr><td>USG</td><td>U.S. Gallons</td><td>BBL</td><td>Barrel</td></tr><tr><td>MG</td><td>MegaGallons</td><td></td><td></td></tr></table></td></tr>
<tr><td>Full Scale Flow
 </td><td>This parameter sets the maximum flow the system is expected to measure. This parameter has influence on other system parameters. These parameters include: Frequency output and current output.

In terms of flow velocity, the meter’s limit are from 0.1 to 12 m/sec.

Moreover the values for Low Flow Cut-off and limits monitoring depend on Full Scale Flow.

The full scale flow is valid for both flow directions.

Note: If the flow rate exceeds the full scale setting, an error message indicates that the configured full scale range has been exceeded.</td></tr>
<tr><td>Low Flow Cut-off
 </td><td>Low Flow Cut-off defines the threshold at which flow measurement will be forced to zero. The cutoff value can be from 0 % to 9.9 % of the full scale flow. Increasing the threshold will help prevent false reading during “no flow” conditions possible caused by vibrations or liquid fluctuations.</td></tr>
</table>

5.2 Main menu

The following menu items are available to you in the main menu:

- Meter setup
- Measuring
- Inputs and outputs
- Reset of the totalizer
- Setting of communication port
- Specific counter settings
- Counter information
- Language selection

5.2.1	Meter Setup
Scale Factor	Changing the scale factor lets you adjust the meter's accuracy without disturbing parameters set by the factory. You can tune the meter to meet changing application requirements.
Empty Pipe Detection	Fluid monitoring shows if measuring pipe has only partly been filled with liquid. Monitoring can be switched on or off. Note: On request, fluid monitoring can be adjusted to fluid's conductivity or to cable length.
Power Line Frequency	For an optimum operation of the meter, set Power Line Frequency in this menu at operating location.
Excitation Frequency	This value shows in which frequency the meter's coils are operated. Supported frequencies are dependent on the configured power line frequency and meter's size. **50 Hz** / **60 Hz** 1 Hz / 1 Hz 3.125 Hz / 3.75 Hz 6.25 Hz / 7.5 Hz 12.5 Hz / 15 Hz Note: When selecting excitation frequency, make sure to always observe that the ratio in respect of power frequency is integer.

Meter Setup	
Pipe Diameter	This figure is used for setting pipe's diameter (size). Several sizes DN 6 to DN 2000 as well as specific sizes in [mm] can be set. Note: Pipe diameter is set at the factory. Changes of size have an impact on meter's accuracy.
Detector Factor	This parameter is set at the factory. This factor compensates for accuracy error as a result of the installed detector. If accuracy adjustment of the meter is required, please refer to the scale factor. In the event the amplifier is replaced, this parameter must be reprogrammed with the original detector factor.
Detector Offset	This parameter is set at the factory. This factor compensates for accuracy error as a result of the installed detector. If accuracy adjustment of the meter is required, please refer to the scale factor.

5.2.2	Measurement
Flow Units	Flow Units let you select among the Flow Units mentioned below. Flow units are automatically converted into the selected unit.

	Unit		Unit
LPS	Liter/Second	GPM	Gallons/Min.
LPM	Liter/Minute	GPH	Gallons/Hour
LPH	Litre/Hour	MGD	MegaGallon/Da
M3S	Cubic meters/Sec.	IGS	UKG/Sec.
M3M	Cubic meters/Min.	IGM	UKG/Min.
M3H	Cubic	IGH	UKG/Hour
F3S	Cubic Feet/Sec.	LbM	Pound/Min.
F3M	Cubic Feet/Min.	OPM	Ounce/Min
F3H	Cubic Feet/Hour.	BPM	Barrel/Min
GPS	Gallons/Sec.	--	--

<table>
<tr><th colspan="2">Measurement</th></tr>
<tr><td>Totalizer Unit
 </td><td>This parameter establishes the units of measure for the totalizers:

<table>
<tr><th></th><th>Unit</th><th></th><th>Unit</th></tr>
<tr><td>L</td><td>Liters</td><td>UKG</td><td>Imperial Gallons</td></tr>
<tr><td>HL</td><td>HectoLiter</td><td>Lb</td><td>Pounds</td></tr>
<tr><td>M³</td><td>Cubic Meters</td><td>Oz</td><td>Fluid Ounces</td></tr>
<tr><td>CFt</td><td>Cubic Feet</td><td>Aft</td><td>Acre Feet</td></tr>
<tr><td>USG</td><td>U.S. Gallons</td><td>BBL</td><td>Barrel</td></tr>
<tr><td>MG</td><td>MegaGallons</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Full Scale Flow
 </td><td>This parameter sets the maximum flow the system is expected to measure. This parameter has influence on other system parameters. These parametes include: Frequency output and current output.

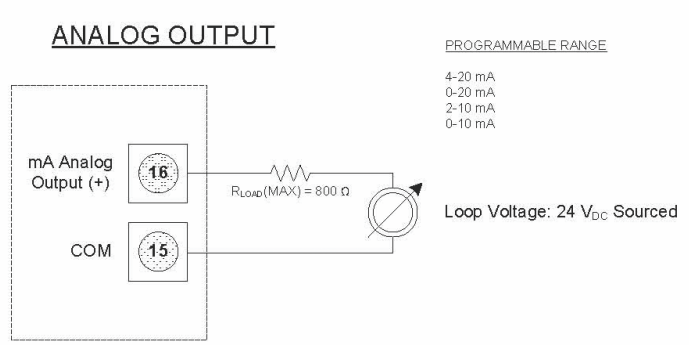
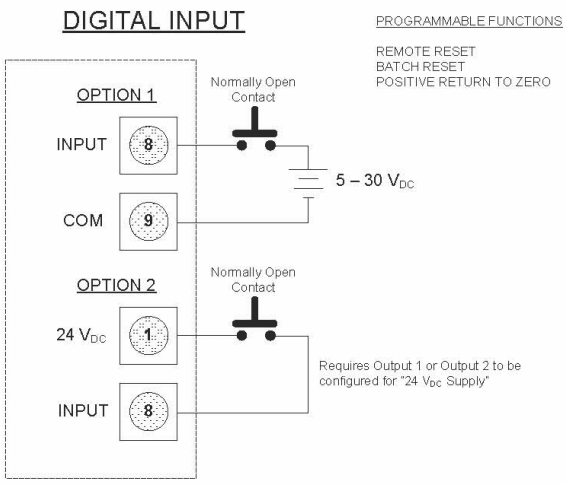
In terms of flow velocity, the meter’s limit are from 0.1 to 12 m/sec.

Moreover the values for Low Flow Cutoff and meter’s limits monitoring depend on Full Scale Flow.

The full scale flow is valid for both flow directions.

Note: If the flow rate exceeds the full scale setting, an error message indicates that the configured full scale range has been exceeded.</td></tr>
<tr><td>Low Flow Cut-off
 </td><td>Low Flow Cut-off defines the threshold at which flow measurement will be forced to zero. The cutoff value can be from 0 % to 9.9 % of the full scale flow. Increasing the threshold will help prevent false reading during “no flow” conditions possible caused by vibrations or liquid fluctuations.</td></tr>
</table>

Measurement	
Flow Direction	Flow direction lets you set the meter to measure forward flow only (uni-directional) or both forward and reverse flow (bidirectional). Unidirectional means that the flow is totalized in only one direction. The flow direction is indicated by the arrow printed on the detector label. In this mode, the two totalizers T1/T2 can be used as totalizers and resettable day counters. Bidirectional means the flow is totalized in both directions. The totalizer T+ registers forward flow and the totalizer T-totalizes in reverse flow direction. The net totalizer TN registers total flow and shows the difference between T+ and T-. A change of the flow direction can be signalized by the digital outputs.
Damping Factor	The damping factor establishes the stability of the measured flow rate.Time constant can be set from “none” up to a max. of 30 seconds. Note: Damping has no influence on the totalizers.

5.2.3	Inputs and Outputs
Analog Output	This parameter establishes the range of the analog output signal: 0 to 100% (= full scale). The following current ranges are available to you: Current output 0 to 20 mA 4 to 20 mA 0 to 10 mA 2 to 10 mA Note: In case that an error message is displayed, set current to 22 mA. In case that you select bidirectional operation, you can signal flow direction via digital outputs. Also see full scale setting. 
Digital Input	Digital input lets you reset totalizers, preselections or interrupt flow measurement. Input switching is provided by applying an external potential of 5 to 30 VDC or by an internal voltage source of 24 VDC. 

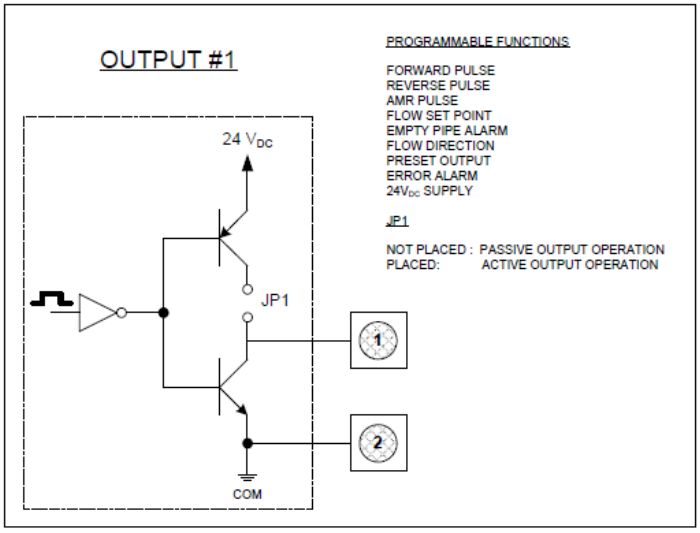
Inputs and Outputs

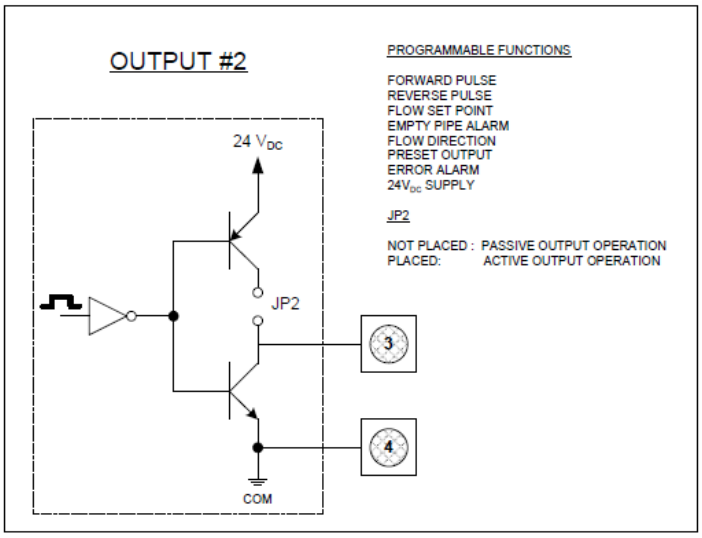
Digital Outputs

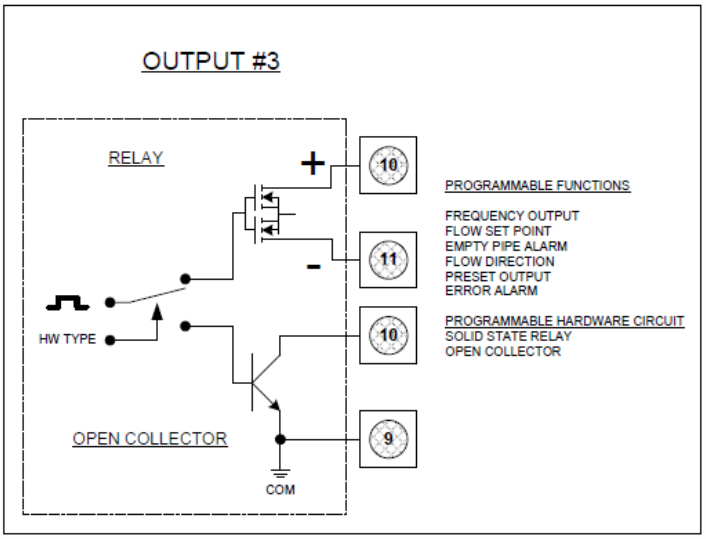
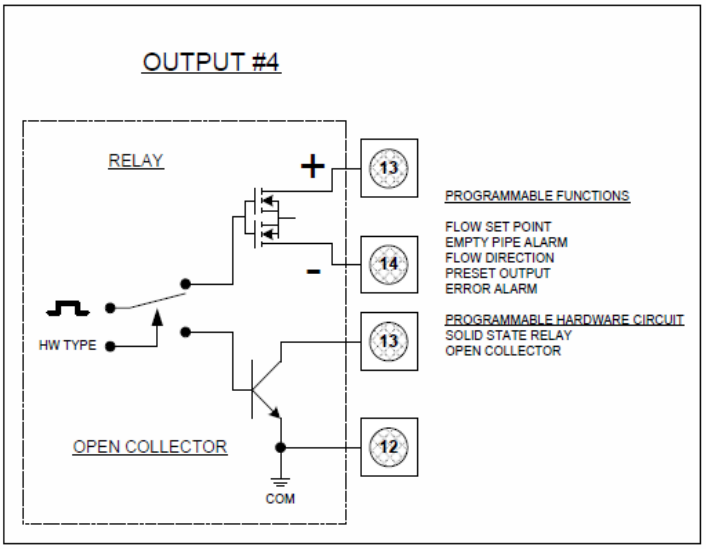
In the sub-menu “Functional operation“ you can configure functional operation of the 4 digital outputs. You can select e.g “forward pulse” for the digital output and define the pulses per totalizer unit via “pulse scale”.

Digital outputs 1 and 2

The two outputs can be operated as open collector passively or actively. Setting can be done via the hardware Jumper JP1 or JP2. Jumper placed means “active output operation“, otherwise “passive output operation“. Jumper placement on circuit board, see chapter 4.3 Configuring inputs and outputs.





Inputs and Outputs	
Digital Outputs	**Digital outputs 3 and 4** The two outputs can be operated as open collector and as relay (solid state relais SSR). You can select operating mode by programming the relative outputs (output hardware).  

<table>
<tr><th colspan="3">Inputs and Outputs</th></tr>
<tr><td>Digital Outputs</td><td>Functional selection
 </td><td>The following functions can be selected for the outputs 1 to 4:
<table><tr><th>Function</th><th>Dig1</th><th>Dig2</th><th>Dig3</th><th>Dig4</th></tr><tr><td>Inactive</td><td>X</td><td>X</td><td>X</td><td>X</td></tr><tr><td>Forward pulse</td><td>X</td><td>X</td><td></td><td></td></tr><tr><td>Reverse pulse</td><td>X</td><td>X</td><td></td><td></td></tr><tr><td>AMR (50 ms)</td><td>X</td><td></td><td></td><td></td></tr><tr><td>Frequency</td><td></td><td></td><td>X</td><td></td></tr><tr><td>Flow set point</td><td>X</td><td>X</td><td>X</td><td>X</td></tr><tr><td>Empty pipe alarm</td><td>X</td><td>X</td><td>X</td><td>X</td></tr><tr><td>Flow direction</td><td>X</td><td>X</td><td>X</td><td>X</td></tr><tr><td>Preset output</td><td>X</td><td>X</td><td>X</td><td>X</td></tr><tr><td>Error alarm</td><td>X</td><td>X</td><td>X</td><td>X</td></tr><tr><td>24 VDC Supply</td><td>X</td><td>X</td><td></td><td></td></tr></table>
<u>Inactive</u> means digital output is switched off.

<u>Forward pulse</u> generates pulses during forward flow conditions.

<u>Reverse pulse</u> generates pulses during reverse flow conditions.

<u>AMR (50 ms)</u> serves for an adaptation to the “Automatic Meter Reading“ system.

<u>Frequency output</u> generates pulses correlated to the absolute value of the flow rate.

<u>Flow set point</u> provides indication when flow rate exceeds thresholds defined by flow set points.

<u>Empty pipe alarm</u> provides indication when pipe is empty.

<u>Flow direction</u> provides indication on current flow direction

<u>Preset output</u> provides indication when preset batch amount has been realized.

<u>Error alarm</u> provides indication when meter has error condition.

<u>24 VDC Suppy</u> provides constant 24 volts on output (forces output type to normally open. The jumper JP1 or JP2 must be placed (active output).</td></tr>
</table>

Inputs and Outputs		
	Pulses/Unit	The Pulses/Unit parameter lets you set how many pulses per unit of measure will be transmitted. The configurable range is from 0.0001 to 99.999 pulses/volume unit, however the max. output frequency of 10,000 pulses/sec. (10 kHZ) must not be exceeded.
	Pulse Width	This parameter establishes the “On” duration of the transmitted pulse. The configurable range ist from 0 msec to 9999 msec. If 0 msec is configured, pulse width is automatically adapted depending on pulse frequency (pulse/pause ratio 1:1). During the configuration the program checks if pulses/unit and pulse width are in accordance with full scale defined, if not an error alarm is displayed. In case of an error alarm, scale, pulse width or full scale need to be adapted.
	Preset Amount	Preset amount lets you set the reset value for the associated PS totalizer when the digital input is set to Batch Reset. You can configure preset amounts from 0.01 to 99999.99 totalizer units in steps of 0.01 volume units. Preset amount is counted down from the configured value to 0 and a digital output shows that the preset amount has been reached. Note: You can only set one preset amount. If you set the preset amount for digital output 1, it will be the same for 2, 3 and 4.
	Flow Set Point	The Flow Set Point (min, max) establishes as a percentage of full scale flow, the threshold at which the output alarm will be activated. You can freely select thresholds in 1% steps. Flow rates below/above the threshold will activate the output alarm.
	Output Type	The Output Type parameter lets you set the output switch to “normally closed“ or “normally open“.

Inputs and Outputs		
	Hardware selection	The hardware type parameter lets you select the type of hardware used to drive the two digital outputs 3 and 4: Either passively as open collector or relay (solid state relais SSR).
	Frequency	This parameter establishes to define the digital output 3 as frequency output. Full scale frequency can be configured from 0 to 10,000 Hz. Output hardware should be defined as open collector – otherwise problems may occur with higher frequencies (> 500 Hz).
Flow Simulation	Flow Simulation provides analog and digital output simulation based on a percentage of the full scale flow in cases where no real flow is occurring. The range of simulation includes -100% to +100% in steps of 10% of the full scale flow.	

5.2.4	Clear Totals
T1	The unidirectional totalizer T1 is reset within the menu manager.
T2	The unidirectional totalizer T2 is reset within the menu manager or with digital input.
T+	The bidirectional totalizer T+ is reset within the menu manager.
T-	The bidirectional reverse flow totalizer T- is reset within the menu manager.
TN	The bidirectional net TN is reset within the menu manager.
VW	The preset batch is reset within the menu manager or with digital input.
Tpwroff	The totalizer accumulating meter time is reset within the menu manager.

5.2.5	Communications	
Port A	The port configuration lets you configure how the RS232 communication port will be used: • Modbus RTU • Remote Menu (remote control) • Disable Port (deactivate port) The **Remote Menu** port will check for display updates once a second. If a change is detected, the display contents will be transmitted in ASCII format over the RS232 communication port. If a suitable PC program is used, the display cannot only be displayed on the PC but the counter can also be configured. The function **Modbus RTU** allows access via a Modbus address that you can configure from 1 to 247 in the menu “Port A Adress“.	
	Port Adress	The range of addresses supported is 1-247. Requests will only be processed if the configured port address of the meter matches with the request address found. Address 0 is processed as “broadcast packets“. Default adress is [1].
	Baud Rate	The following baud rates are supported: • 9600 • 19200 • 38400 Default setting is [9600 baud].
	Parity	The following parities are supported: • Even • Odd • None Default setting is [Even]

<table>
<tr><th colspan="3">Communications</th></tr>
<tr><td></td><td>Data Bits
 </td><td>The following data bits are supported:
8 bits
7 bits
5 bits
Default settting is [8 bits]</td></tr>
<tr><td></td><td>Stop Bits
 </td><td>The following stop bits are supported:
1 Stop Bit
2 Stop Bits
Default setting is [1 Stop Bit]</td></tr>
<tr><td>Port B</td><td colspan="2">This port cannot be configured.</td></tr>
<tr><td>Diagnostics Port A
 </td><td colspan="2">This function allows diagnostics in cases where the port Modbus RTU is used.

<table>
<tr><th>Counter</th><th>Description</th></tr>
<tr><td>Pkts Processed</td><td>Number of packets processed by meter.</td></tr>
<tr><td>Broadcast Pkts</td><td>Number of broadcast packets (Address = 0) processed by meter.</td></tr>
<tr><td>CRC Errors</td><td>Number of received packets with CRC error; packet is discarded.</td></tr>
<tr><td>Pkts Rcvd</td><td>Number of packets received with an address of the configured port address</td></tr>
<tr><td>Pkts Sent</td><td>No. of packets transmitted in response to a received</td></tr>
<tr><td>Parity Errors</td><td>Number of characters with parity errors; packet is discarded.</td></tr>
<tr><td>Framing Errors</td><td>Number of characters with framing error (e.g. missing stop bit – synchronization problem); packet is discarded.</td></tr>
<tr><td>Overrun Errors</td><td>Number of received characters that were not processed due to degradation of system performance.</td></tr>
<tr><td>Break Detects</td><td>Number of breaks during transmission.</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>5.2.6</td><td colspan="2">Advanced</td></tr>
<tr><td>Unit Multiplier
 </td><td colspan="2">This function lets you define totalizers' formatting. You can select among the following formats:

<table><tr><th colspan="2">Format</th></tr><tr><td>0.0001</td><td>1</td></tr><tr><td>0.001</td><td>10</td></tr><tr><td>0.01</td><td>100</td></tr><tr><td>0.1</td><td>1000</td></tr></table>
Formatting is normally [Aus/off]. With this function, the best possible resolution is automatically chosen.</td></tr>
<tr><td>Backlight Control
 </td><td colspan="2">You can set the meter's backlight to “Aways On“, “Always Off“ or “Time (1 min)”.

When set to “Time (1 min)“, the backlight will automatically turn off after one minute of inactivity (no buttons pressed). Pressing one of three buttons will turn the backlight on.

Note: A longer operation with the option „always on“ can have a negative effect on LCD's life.</td></tr>
<tr><td rowspan="2">Analog Calibrate</td><td colspan="2">Analog calibrate lets you configure the current output.

Note: The analog output was already set at the factory. Normally an additional calibration is not necessary. In the event that you wish to adapt the output to your external system, see “corrective factor“.</td></tr>
<tr><td>Corrective Factor
 </td><td>The analog output was already set at the factory to exactly 4.00 mA (zero) und 20.00 mA (margin). In the event that your external system shows another parameter, you can simply correct the offset via this function.

First select “Set 4 mA Offset“ and enter another parameter for zero. In the event that your system shows 3.70 mA instead of 4.00 mA, enter the difference of -00.30 mA as corrective factor. The same applies to the item “Set 20 mA Offset“ in order to correct the margin.</td></tr>
</table>

Advanced		
	Factory setting	The analog output was already set at the factory to exactly 4.00 mA (zero) and 20.00 mA (margin). In case that you wish to adapt your external system, use the item “corrective factor“.
Software Filter	This filter is intended to help eliminate unrequested peaks during measurement.	
	Activation	Activates or deactivates the software filter
	Filter Delay	Filter Delay lets you set the amount of time that the flow will be held constant once the filter is activated (change of flow per time unit).
	Acceleration Factor	This parameter lets you set the maximum acceleration for a given pipe diameter (change of flow per time unit). If the realized fluid acceleration exceeds the configured maxi-mum acceleration, fluid flow will be held constant for the time set at the Filter Delay parameter.
	Constant Flow	This parameter lets you set the acceleration limit for a constant flow.
	Peak Detect	Peak Defect offers a diagnostic view of acceleration components observed during flow condition and records the “high water mark“. Press **+** button to reset.

Advanced	
Empty Pipe Cal.	Note: To compensate different fluid conductivity, signal cable lengths or sizes during measurements, you can calibrate them accordingly. This is important in case that fluid monitoring has been activated and “empty pipe” is signalized although the pipe is filled. Proceed as follows: 1. Select “Empty Pipe Cal“ 2. Set calibration to “CAl [on]“ 3. Observe the voltage “Volt“ 4. When stable, select “Store“ and press **E** 5. Fill pipe with fluid 6. Select “Cal. Pipe Full“ 7. Set calibration to “Cal [AN]“ 8. Observe the voltage “Volt“ 9. When stable, select “Store“ and press **E**
Password Security	There are three possible access levels, each with its own unique password: • Administrartor PIN • Service PIN • User PIN The password security consists of a five-digit PIN and is set at the factory to [00000]. Enter a number above zero to activate password security. Activate password security in the following order: Administrator, Service, User. Note: You cannot activate the user password before administrator and service passwords have been activated. About 5 minutes after configuration, password security becomes active. As soon as password security has become active, a PIN is required for configuration. Depending on the individual PINs, you are either in the administrator, service or user levels with corresponding access rights (identified in the operating manual by the lock A, S and B).

5.2.7	Info/Help	
Error Counts	The following list gives you an overview about the kind and frequency of various messages and hence provides a diagnostic of the counter or the measuring point. Prior to any diagnostic, we suggest to reset the individual parameters in order to exclude impacts occurring due to installation, maintenance or other anormal operation conditions. You can reset the individual parameters by selecting them with the cursor and by pressing **E**. Select “number“ and press **E** [J]. Select „store“ and press again **E**.	
	Detector	The number of times an invalid detector condition has been observed
	Empty Pipe	The number of times an empty pipe condition has been observed by the meter
	Full Scale	The number of times the flow has exceeded the full scale setting
	Totalizer	The number of times the totalizers have exceeded limits of the meter
	Pulse Sync.	The number of times the pulse outputs have fallen out of synchronization
	ADC Interrupt	The number of times an analog input measurement has been missed
	ADC Range	The number of times the analog input measurement range has been exceeded
	System Error	A diagnostic system message indicating the reason for a system reset
	System Resets	The number of times the meter has been reset
	System Reset ID	Diagnostic information about a system reset as a result of expired internal timers
Rollover Counts	The number of times the totalizers have rolled over. Note: The totalizer can show a max. of 10 digits in the display. In the following, it is set to zero again and rollover count is incremented by one.	

5.2.7	Info/Help
PowerUp Counter	The number of times that the unit has been powered on.
Power Off Time	The length of time that the unit has been without power. This parameter “Tpwroff“ can be set with the menu “Reset Totalizer“.
Version info	The current software version of the unit.
Serial number	The manufacturing serial number of the installed electronics in the format YYMM####.
Restore Default	Restores all non-calibrated parameters to the factory defaults.
Restore Calibration	Restores the meter calibration as set at the factory.

5.2.8	Language Select
Language select	The unit supports English along with one alternate language. The alternate language choice is set at the factory.

6. Troubleshooting

Error messages can be displayed via the 4 digital outputs. By means of the error list type and frequency of the errors can be logged and analyzed, also see chapter Programming: Info/Help.

The following error messages can be displayed:

Description	Possible Cause	Recommended Action
Err: Coil	▪ Meter not connected. ▪ Connection to meter interrupted. ▪ Detector electronics or coils defective.	Check if meter is connected and make sure that cable connection is not interrupted. Otherwise contact Service Department.
Wrn: Pulse Sync	False synchronization of pulse output	
Err: empty pipe	Pipe may not be full.	Make sure that pipe is always filled at the measuring point. Eventually calibrate anew, see calibration of fluid monitoring
Err: full scale	Actual flow rate is exceeding the programmed.	Reduce flow rate or increase the programmed full scale.
Err: ADC range	Input signal from detector too high.	Check the grounding scheme of the meter installation. See grounding section in manual.
Err: Tot. rollover	Number of totalizer digits is exceeded	See programming / Info/Help / Totalizer Rollover
Err: ATOD INT	No measuring signal on analog input.	Contact service.

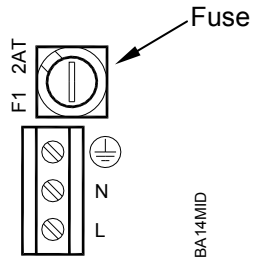
Some frequently occurring errors are listed in the following:

Other error	Possible Cause	Recommended Action
Meter does not function	▪ No auxiliary power. ▪ Fuse defective.	▪ Provide auxiliary power. ▪ Replace fuse.
Fluid is flowing, however display shows zero	▪ Signal cable is not connected or connection is interrupted. ▪ Detector installed opposite to forward flow direction (see arrow on type plate). ▪ Connection cable for coils or electrodes mixed-up.	▪ Check signal cable. ▪ Turn detector by 180°. ▪ Check connection cable.
Inaccurate measurement	▪ Wrong parameters. ▪ Pipe not completely full.	▪ Check parameters (detector, amplifier and size) as per annexed data sheet ▪ Check if measuring pipe completely full.

6.1 Replacing the fuse

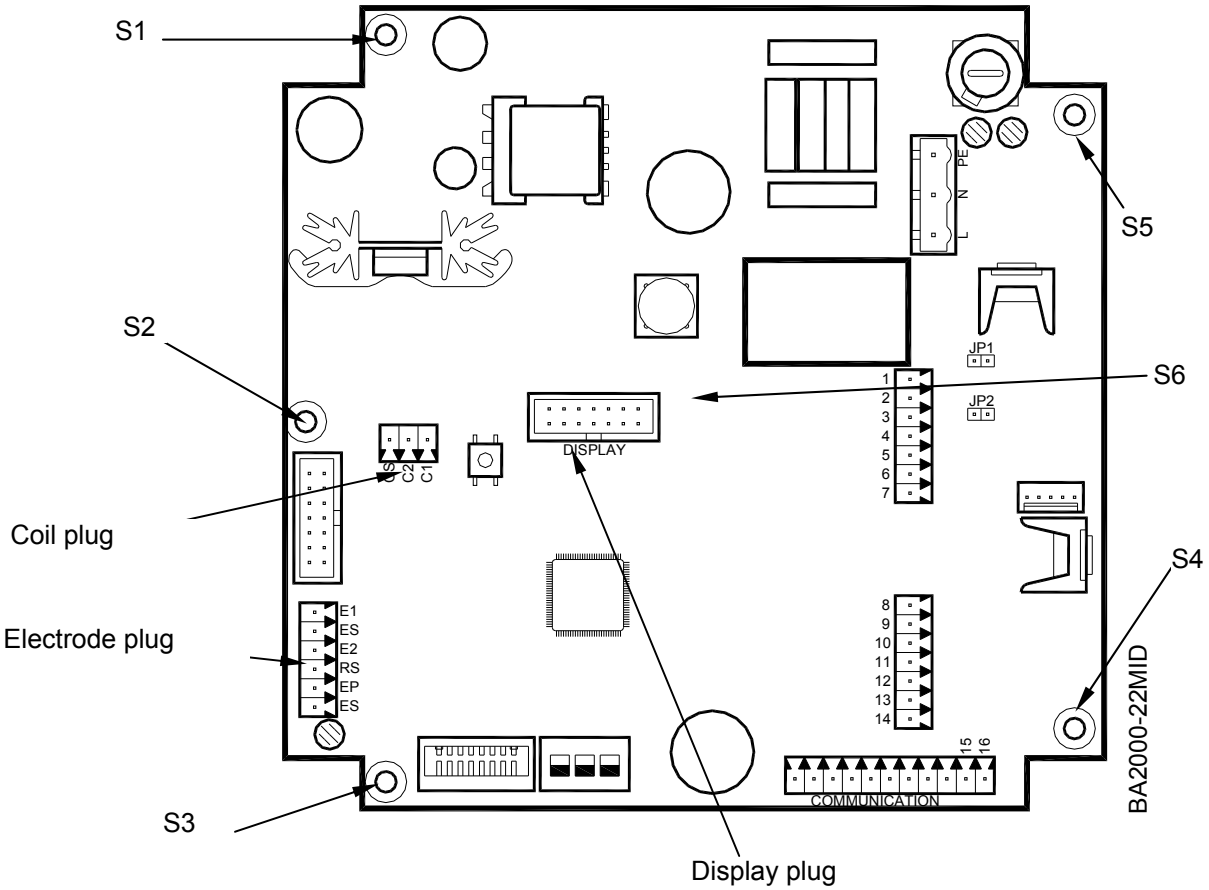
Warning: • *Disconnect main power to the unit before replacing the fuse.*

Fuse type: T2 H 250 V (2A idle)



6.2 Replace meter's electronics

Warning: • *Disconnect auxiliary power before opening body cover.*



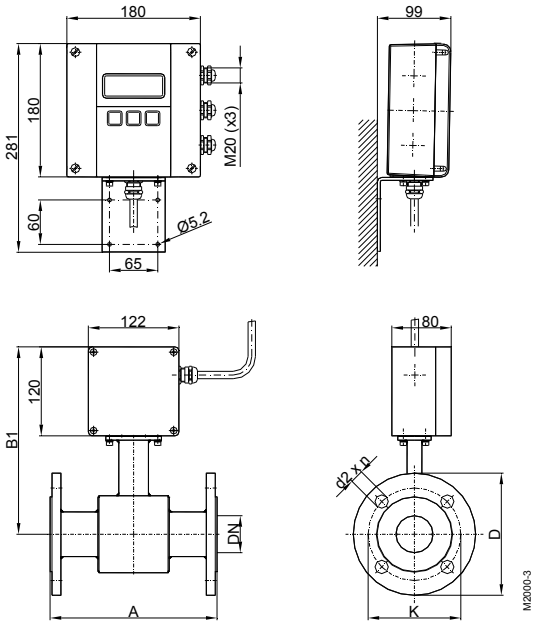
1. Pull out electrode, coil and display plugs. Loosen screws S1-S6 and take out circuit board.
2. Insert new circuit board and fix it by fastening the screws S1-S6. Plug again the three plugs.
3. If necessary, configure new circuit board related to the available meter (detector, size).

7. Technical data

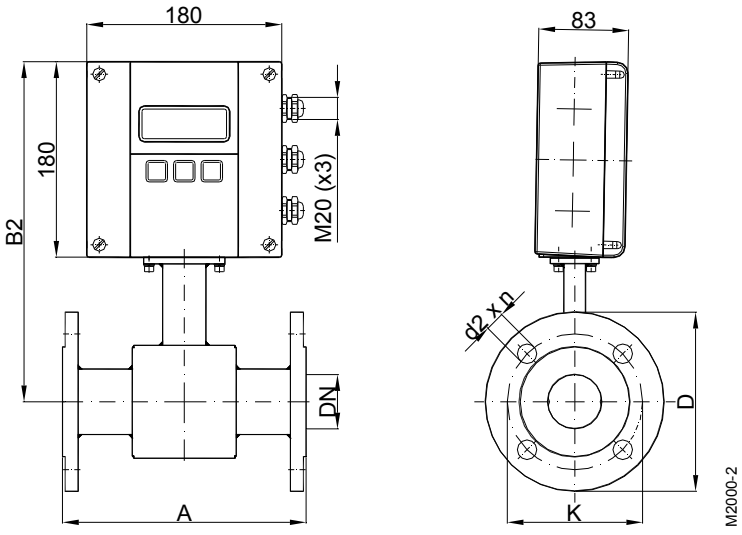
7.1 Detector Type II

Technical data			
Size	DN 6 – 2000 (1/4“...80“)		
Process connections	Flange: DIN, ANSI, JIS, AWWA etc.		
Nominal pressure	Up to PN 100		
Protection class	IP 67, IP 68 optional		
Min. conductivity	5 µS/cm (20 µS/cm demineralized water)		
Liners	Hard/soft rubber	from DN 25 onward	0 to +80°C
	PTFE	DN 6 - 600	-40 to +150°C
	Halar (ECTFE)	ab DN 300	-40 to +150°C
Electrodes	Hastelloy C (Standard) Tantalum	Platinum/Gold platinized Platinum/Rhodium	
Body	Steel/stainless steel optional		
Overall length	DN 6 – 20	170 mm	
	DN 25 – 50	225 mm	
	DN 65 – 100	280 mm	
	DN 125 – 200	400 mm	
	DN 250 – 350	500 mm	
	DN 400 – 750	600 mm	
	DN 800 – 1000	800 mm	
	DN 1200 – 1400	1000 mm	
	DN 1600	1600 mm	
	DN 1800	1800 mm	
	DN 2000	2000 mm	

Process connection flange
M2000® wall mounting



Process connection flange
M2000® mounted version



DN		A Std*	A ISO**	B1	B2	ANSI flanges			DIN flanges		
						∅ D	∅ K	∅ d2xn	∅ D	∅ K	∅ d2xn
6	1/4”	170	---	228	288	88,9	60,3	15,9 x 4	90	60	14 x 4
8	3/10”	170	---	228	288	88,9	60,3	15,9 x 4	90	60	14 x 4
10	3/8”	170	---	228	288	88,9	60,3	15,9 x 4	90	60	14 x 4
15	1/2”	170	200	238	298	88,9	60,3	15,9 x 4	95	65	14 x 4
20	3/4”	170	200	238	298	98,4	69,8	15,9 x 4	105	75	14 x 4
25	1”	225	200	238	298	107,9	79,4	15,9 x 4	115	85	14 x 4
32	1 1/4”	225	200	253	313	117,5	88,9	15,9 x 4	140	100	18 x 4
40	1 1/2”	225	200	253	313	127	98,4	15,9 x 4	150	110	18 x 4
50	2”	225	200	253	313	152,4	120,6	19 x 4	165	125	18 x 4
65	2 1/2”	280	200	271	331	177,8	139,7	19 x 4	185	145	18 x 4
80	3”	280	200	271	331	190,5	152,4	19 x 4	200	160	18 x 8
100	4”	280	250	278	338	228,6	190,5	19 x 8	220	180	18 x 8
125	5”	400	250	298	358	254	215,9	22,2 x 8	250	210	18 x 8
150	6”	400	300	310	370	279,4	241,3	22,2 x 8	285	240	22 x 8
200	8”	400	350	338	398	342,9	298,4	22,2 x 8	340	295	22 x 12
250	10”	500	450	362	422	406,4	361,9	25,4 x 12	395	350	22 x 12
300	12”	500	500	425	485	482,6	431,8	25,4 x 12	445	400	22 x 12
350	14”	500	550	450	510	533,4	476,2	28,6 x 12	505	460	22 x 16
400	16”	600	600	475	535	596,9	539,7	28,6 x 16	565	515	26 x 16
450	18”	600	---	500	560	635,0	577,8	31,7 x 16	615	565	26 x 20
500	20”	600	---	525	585	698,5	635,0	31,7 x 20	670	620	26 x 20
550	22”	600	---	550	610	749,3	692,1	34,9 x 20	---	---	---
600	24”	600	---	588	648	812,8	749,3	34,9 x 20	780	725	30 x 20
650	26”	600	---	613	673	869,9	806,4	34,9 x 24	---	---	---
700	28”	600	---	625	685	927,1	863,6	35,1 x 28	895	840	30 x 24
750	30”	800	---	650	710	984,2	914,4	34,9 x 28	---	---	---
800	32”	800	---	683	743	1060,5	977,9	41,3 x 28	1015	950	33 x 24
850	34”	800	---	708	768	1111,2	1028,7	41,3 x 32	---	---	---
900	36”	800	---	725	785	1168,4	1085,8	41,3 x 32	1115	1050	33 x 28
950	38”	800	---	750	810	1238,3	1149,4	41,3 x 32	---	---	---
1000	40”	800	---	790	850	1346,2	1257,3	41,3 x 36	1230	1160	36 x 28
1200	48”	1000	---	900	960	1511,5	1422,4	41,3 x 44	1455	1380	39 x 32
1350	54”	1000	---	975	1035	1682,8	1593,9	47,8 x 44	---	---	---
1400	56”	1000	---	1000	1060	---	---	---	1675	1590	42 x 36

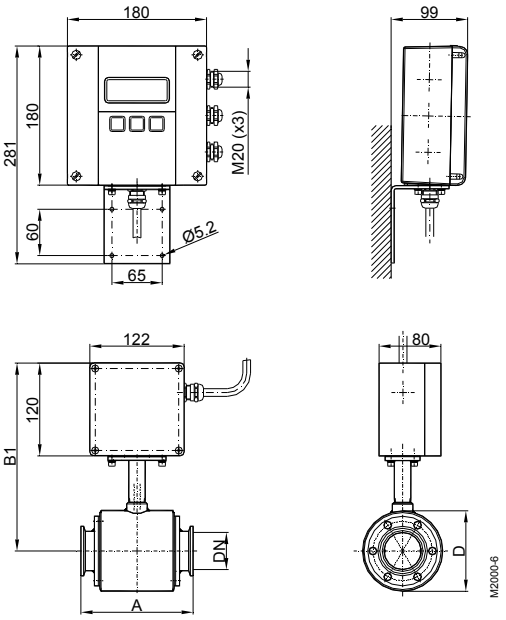
Standard		
ANSI flanges	from DN 6 - 2000	pressure 150 lbs
DIN flanges	from DN 6 – 200	pressure PN 16
	from DN 250 – 2000	pressure PN 10

* Standard **ISO 13359

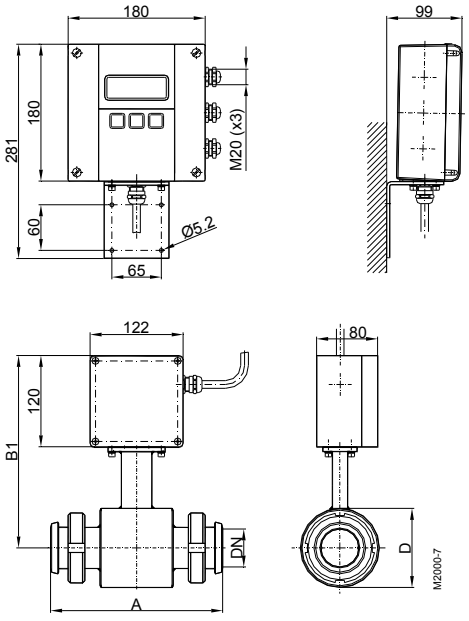
7.2 Detector type Food

Technical data			
Size	DN 10 – 100 (3/8“...4“)		
Process connections	Tri-Clamp®, DIN 11851, ISO 2852, etc.		
Nominal pressure	PN 10		
Protective class	IP 65, IP 68 optional		
Min. conductivity	5 µS/cm (20 µS/cm demineralized water)		
Liners	PTFE	-40 to +150°C	
Electrodes	Hastelloy C (Standard) Tantalum	Platinum/Gold platinized Platinum/Rhodium	
Body	Stainless steel		
Overall length	Tri-Clamp® connection	DN 10 – 50	145 mm
		DN 65 – 100	200 mm
	DIN 11851 connection	DN 10 – 20	170 mm
		DN 25 – 50	225 mm
		DN 65 – 100	280 mm

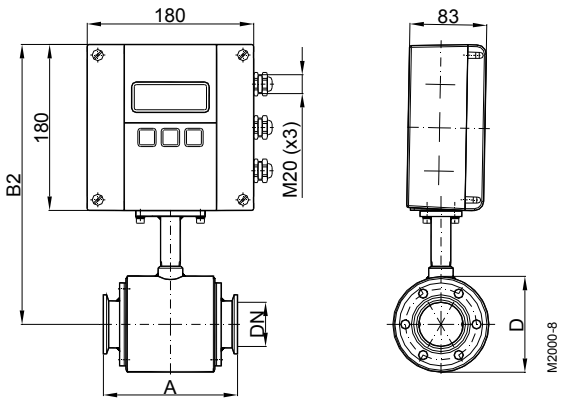
Process connection Tri-Clamp®
M2000® Wall mounting



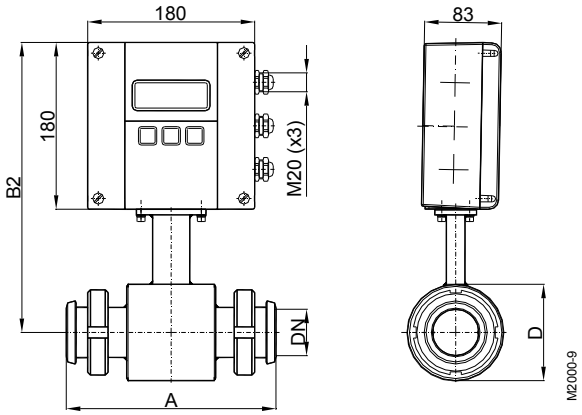
Process connection DIN 11851
M2000® Wall mounting



Process connection Tri-Clamp®
M2000® mounted version



Process connection DIN 11851
M2000® mounted version



Type Food Tri-Clamp®

DN		A	B1	B2	D
10	3/8”	145	228	174	74
15	1/2”	145	228	174	74
20	3/4”	145	228	174	74
25	1”	145	228	174	74
40	1 ½“	145	238	184	94
50	2”	145	243	189	104
65	2 ½“	200	256	202	129
80	3”	200	261	207	140
100	4”	200	269	215	156
Pressure PN 10			Dimensions (mm)		

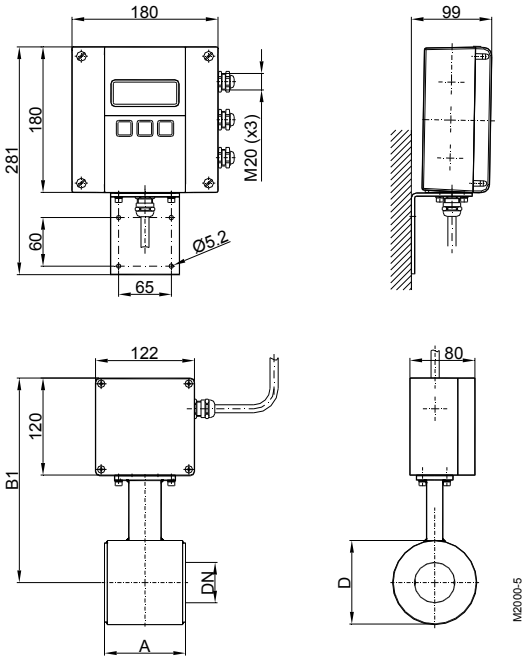
Type Food Milk Pipe DIN 11851

DN		A	B1	B2	D
10	3/8”	170	238	184	74
15	1/2”	170	238	184	74
20	3/4”	170	238	184	74
25	1”	225	238	184	74
32	1 ¼“	225	243	189	84
40	1 ½“	225	248	194	94
50	2”	225	253	199	104
65	2 ½“	280	266	212	129
80	3”	280	271	217	140
100	4”	280	279	225	156
Pressure PN 16			Dimensions (mm)		

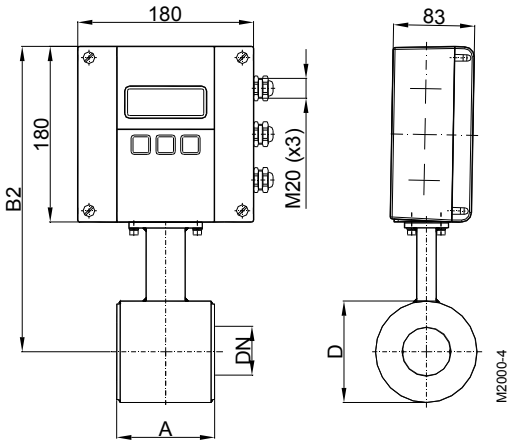
7.3 Detector Type III

Technical Data		
Size	DN 25 – 100 (1“...4“)	
Process connections	Sandwich connection, (intermediate flange mounting)	
Nominal pressure	PN 40	
Protective class	IP 67, IP 68 optional	
Min. conductivity	5 µS/cm (20 µS/cm demineralized water)	
Liner	PTFE	-40 to +150°C
Electrodes	Hastelloy C (Standard) Tantalum	Platinum/Gold platinized Platinum/Rhodium
Body	Steel/stainless steel optional	
Overall length	DN 25 – 50	100 mm
	DN 65 – 100	150 mm

Sandwich connection
M2000® wall mounting



Sandwich connection
M2000® mounted version

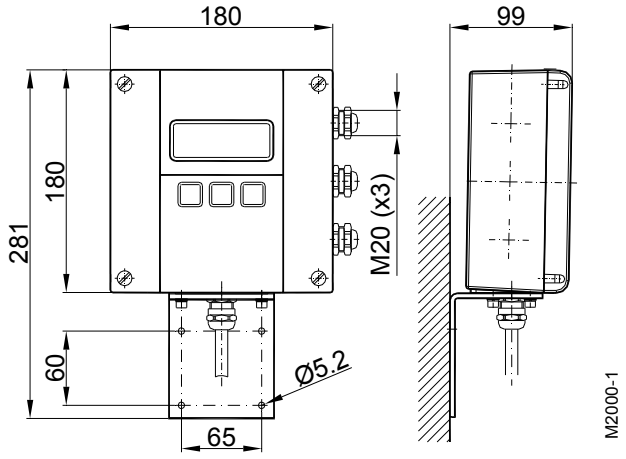


DN		A	B1	B2	D
25	1”	100	238	184	74
32	1 ¼“	100	243	189	84
40	1 ½“	100	248	194	94
50	2”	100	253	199	104
65	2 ½““	150	266	212	129
80	3”	150	271	217	140
100	4”	150	279	225	156
Pressure PN 40					

7.4 Meter type M2000®

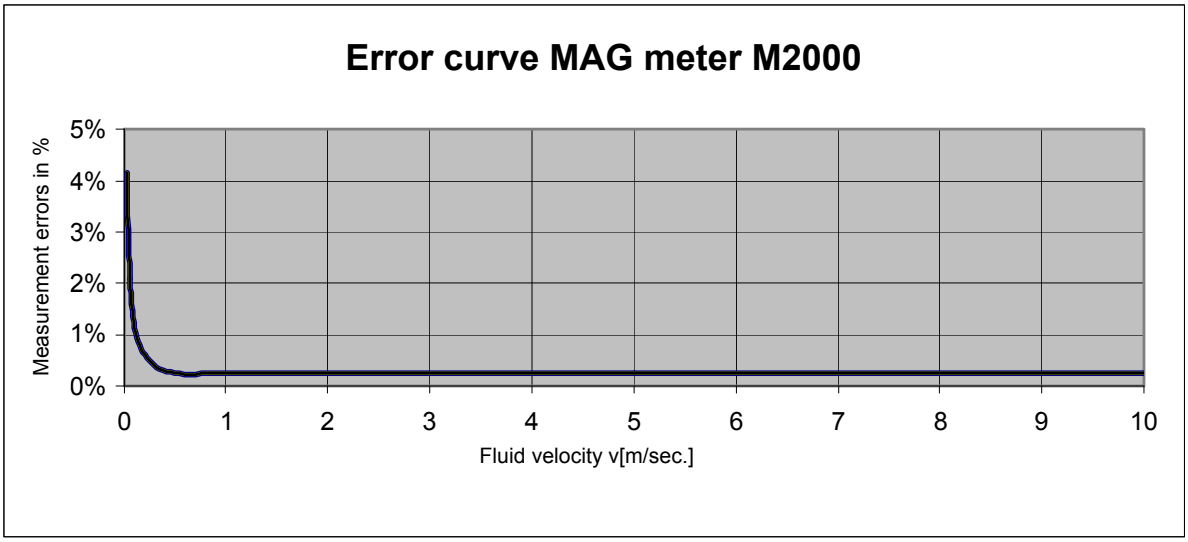
Technical data	
Type	M2000®
Auxiliary power	85 – 265 VAC, 45 – 65 Hz Optional 24 VDC (-10% … +20%), 900 mA
Analog output	0/4 – 20 mA, ≤ 800 Ohm
	Flow direction is displayed via separate status output
Digital outputs	4 freely configurable open collector outputs Active 24 V, 50 mA or Passiv 30 VDC, 100 mA max. frequency of 10 kHz Pulse, limit, preselector, statur, error messages
Digital inputs	Totalizers and preselectors reset Positive Zero Return
Fluid monitoring	Separate electrode
Configuration	3 buttons
Ports	RS 232 – Remote display or Modbus RTU
Measuring range	0,03 to 12 m/s
Measuring accuracy	≥ 0,5 m/sec. better ±0,25% < 0,5 m/sec. ±1,25 mm/sec.
Reproducibility	0,1%
Flow direction	Bidirectional
Pulse length	Configurable up to 2000 msec.
Outputs	Short-circuit-proof and galvanically separated
Low flow cutoff	0 – 10%
Display	LCD, 4 lines/20 digits, backlight, actual flow rate, totalizers, status display
Body	Powder-coated alu die casting
Protective class	IP 67
Cable inlet	Supply and signal cables 3 x M20
Signal cable	From meter M20
Ambient temperature	-20 to + 60°C

Dimensions M2000®



7.5 Error limits

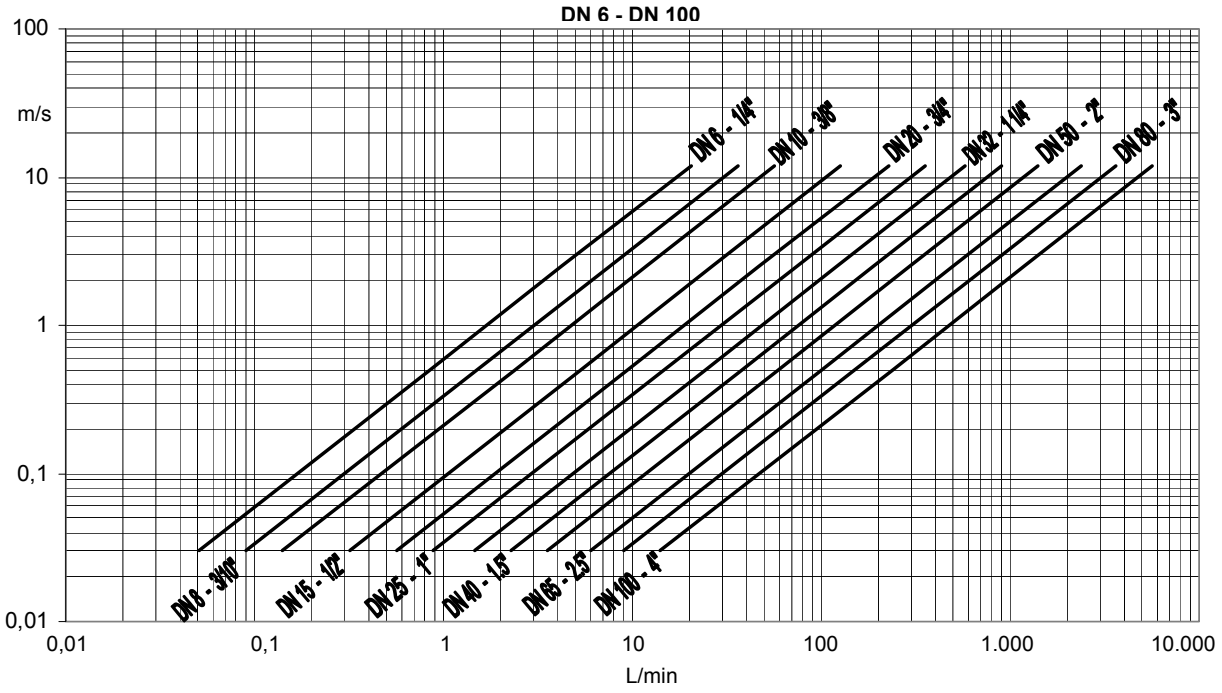
Measuring range	:	0,03 m/sec. to 12 m/sec.
Pulse output	:	≥ 0,5 m/sec. ±0,25% < 0,5 m/sec. ± 1,25 mm/sec.
Analog output	:	Similar to pulse output plus ±0,01 mA
Reproducibility	:	±0,1%

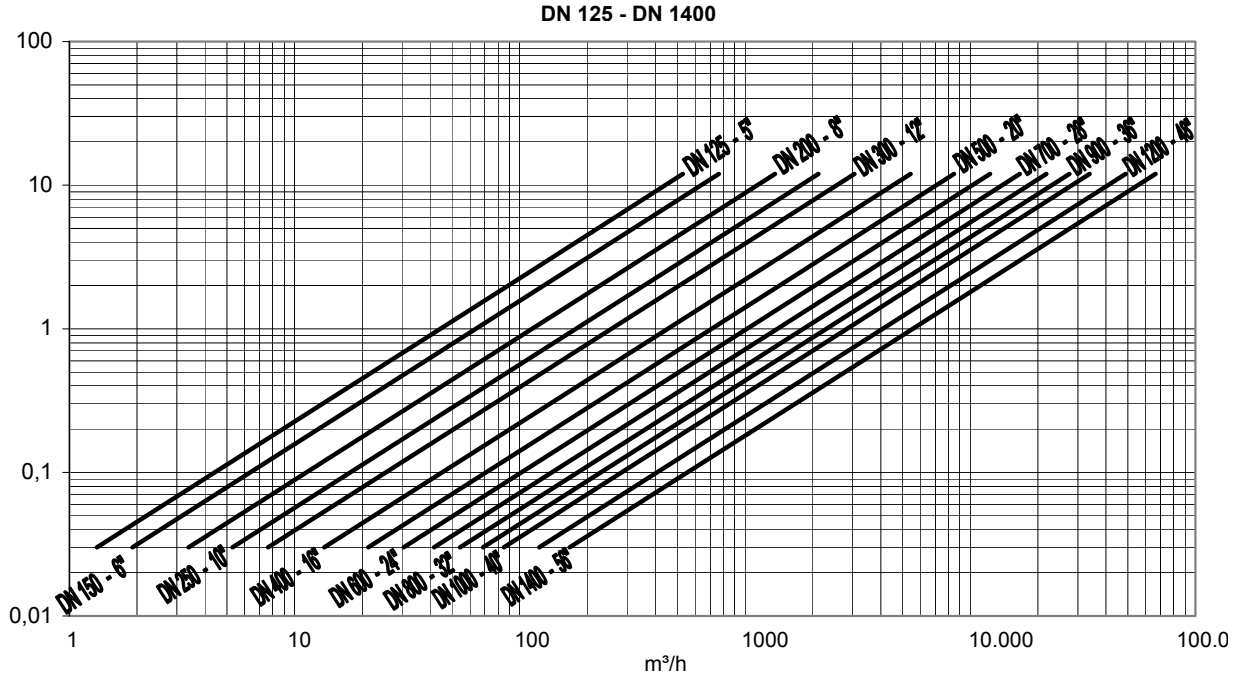


Reference conditions:

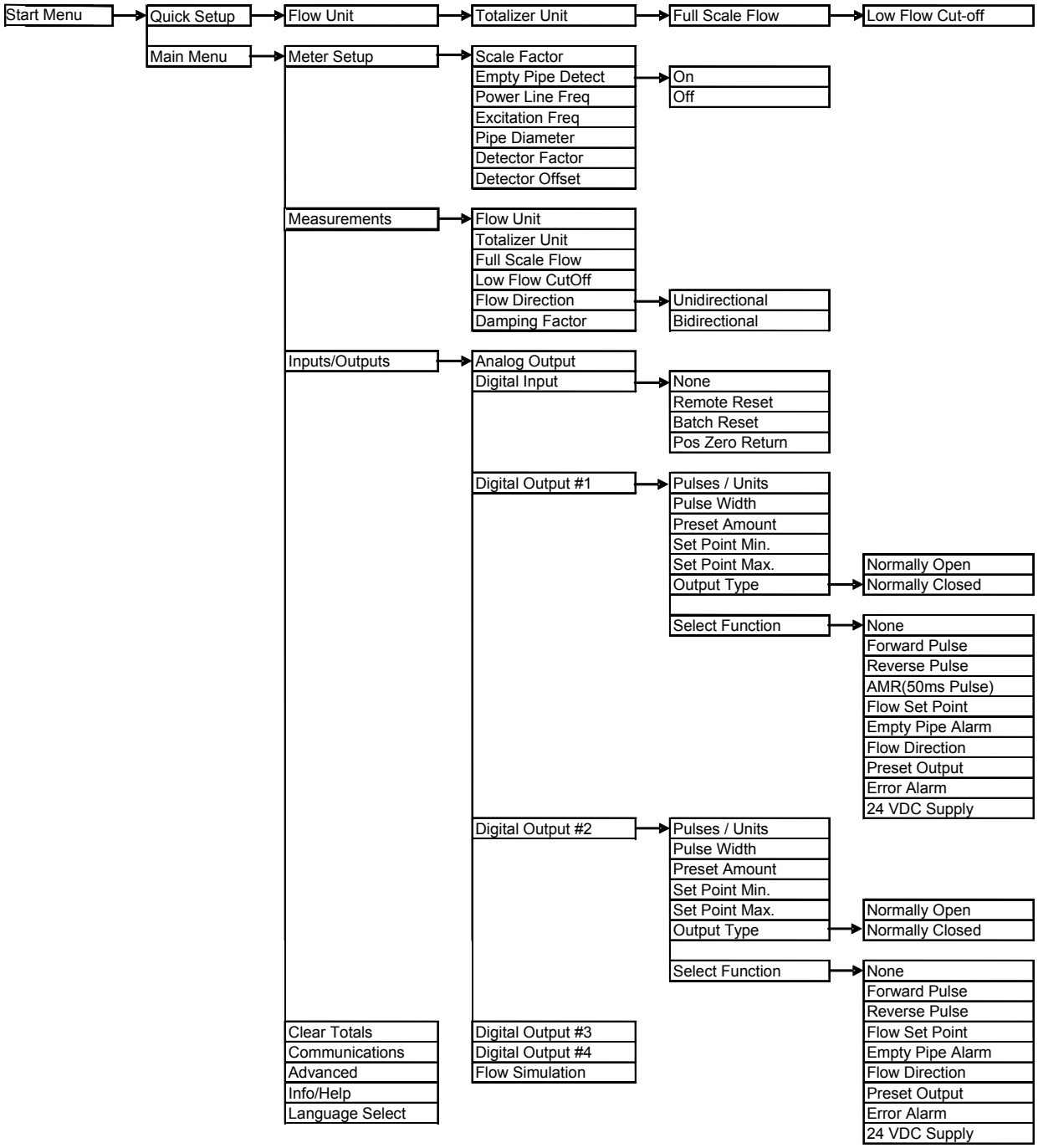
Ambient and fluid temperature	:	20°C
Electr. conductivity	:	> 300 µS/cm
Warm-up period	:	60 min
Mounting conditions	:	> 10 DN inlet pipe > 5 DN outlet pipe Detector properly grounded and centered.

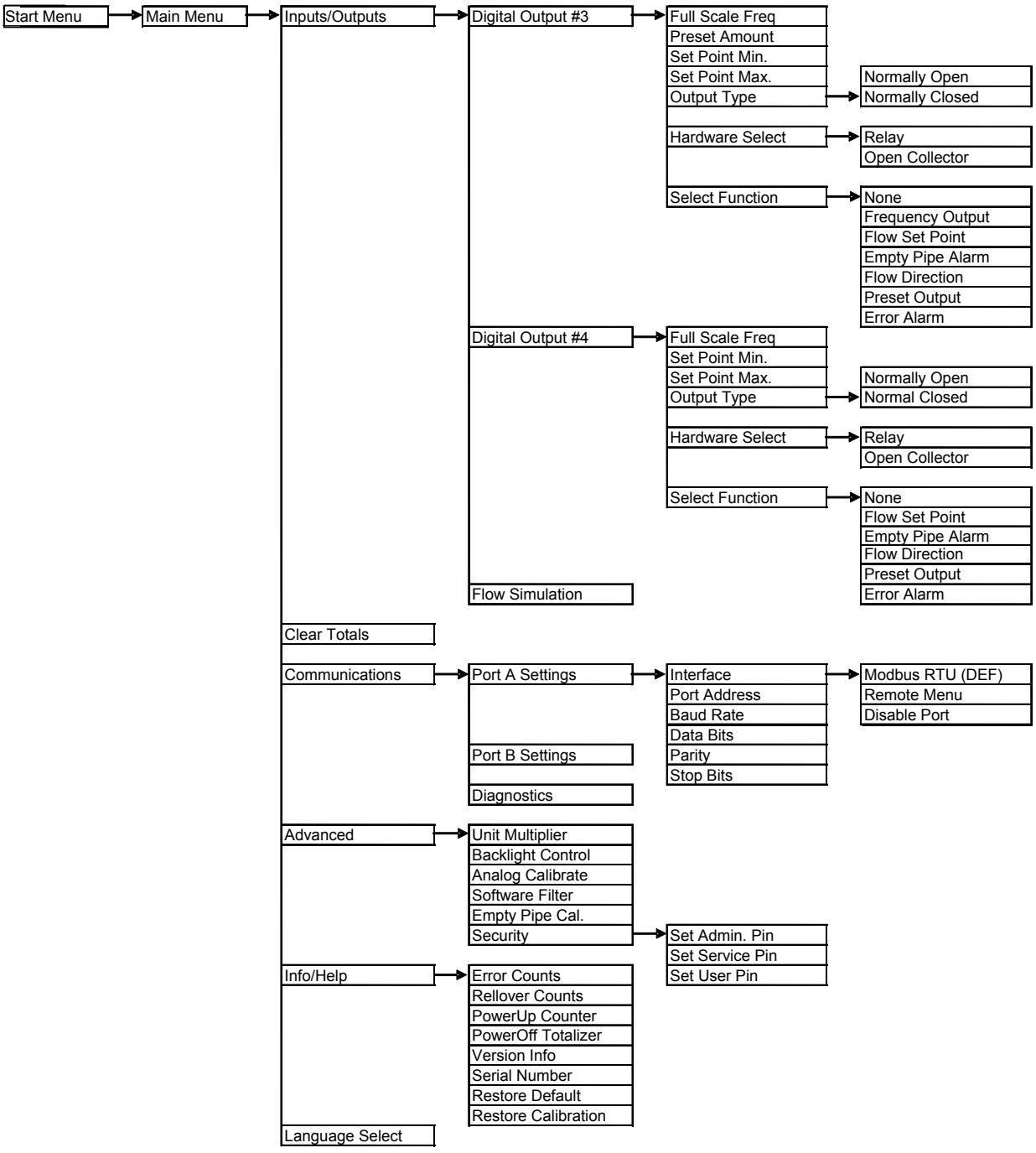
7.6 Size select





8. Program structure




Start Menu
Main Menu
Inputs/Outputs
Digital Output #3
Full Scale Freq
Preset Amount
Set Point Min.
Set Point Max.
Output Type
Normally Open
Normally Closed
Hardware Select
Relay
Open Collector
Select Function
None
Frequency Output
Flow Set Point
Empty Pipe Alarm
Flow Direction
Preset Output
Error Alarm
Digital Output #4
Full Scale Freq
Set Point Min.
Set Point Max.
Output Type
Normally Open
Normal Closed
Hardware Select
Relay
Open Collector
Select Function
None
Flow Set Point
Empty Pipe Alarm
Flow Direction
Preset Output
Error Alarm
Flow Simulation
Clear Totals
Communications
Port A Settings
Interface
Modbus RTU (DEF)
Port Address
Remote Menu
Baud Rate
Disable Port
Data Bits
Parity
Stop Bits
Port B Settings
Diagnostics
Advanced
Unit Multiplier
Backlight Control
Analog Calibrate
Software Filter
Empty Pipe Cal.
Security
Set Admin. Pin
Set Service Pin
Set User Pin
Info/Help
Error Counts
Rellover Counts
PowerUp Counter
PowerOff Totalizer
Version Info
Serial Number
Restore Default
Restore Calibration
Language Select

9. Return of goods for repair

Please copy, fill in and sign hereafter harmlessness declaration and enclose it for any return of goods you may send back for repair.

No repair will be performed prior to receiving the harmlessness declaration duly filled and signed.

Harmlessness declaration

To : _____

Attn. : _____

From : _____

Dept. : _____

Please note that no repair will be performed prior to receiving of this declaration duly signed by you!

Please send all parts clean from medium and inform us about possible medium wastes remaining in the part. For this purpose, please use this form. A security specification sheet of the medium must accompany this declaration in the following cases: Toxical, dangerous or objectionable media, or media belonging to any dangerous materials class. We inform you that uncleaned parts lead to additional costs. Extra clean costs will be charged to you. Furthermore, we reserve us the right to send the parts back to you for cleaning!

Declaration

We herewith confirm that the part(s) sent for repair has/have been cleaned and is/are free of any liquid and/or solid wastes of the medium and/or cleaning medium: Any eventually remaining wastes are:

❍ harmless

❍ dangerous, toxic, etc. – Security specifications are attached

Signature of person in charge: _____

Name of the person in charge in capital letters: _____

Date: _____

Company stamp: _____

Hotline

Phone +49-7025-9208-0 or -30
Fax +49-7025-9208-15

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